

On-Farm Irrigation

PUBLICATION

Drip and Microirrigation for Trees, Vines, and Row Crops

(with special sections on buried drip)

Water Management Series

Irrigation Training and Research Center (ITRC)

Department of Agricultural Engineering

California Polytechnic State University (Cal Poly) 1994

By:

Charles M. Burt

Stuart W. Styles

Table of Contents:

Section 1.

Drip And Microirrigation - General Principles

Chapter 1. Background To Drip/Microirrigation

Chapter 2. Irrigation Efficiency and Uniformity

Introduction

Initial Definitions and Terms

Distribution Uniformity (Du)

Emission Uniformity (Eu)

Beneficial Use

Reasonable Use

Irrigation Efficiency (Ie)

Irrigation Sagacity (Is)

On-Farm Irrigation Evaluations

Water Destination Diagrams

Distribution Uniformity

General

Coefficient Of Variation (Cv)

The Global Uniformity Concept

Combining Various Du Components

Du Of A Brand New System

Actual vs. Potential Du

Microirrigation Deterioration with Time Evaluating Drip/Microirrigation Systems

Chapter 3. System Flow Rate Requirements

- Crop Evapotranspiration (Et)
- Published Et Values
- Soil Wetted Volume
- Application Rates
 - Net Vs. Gross
 - Peak Et Application Rate Per Day
 - Hours of Pump Operation Per Day or Week
 - The Effects of A Slight Under-Irrigation

Chapter 4. Emitter/Sprayer Designs

- General
- Emitter Attachment
- Emitter Discharge Exponent
- Emitter Path Type
- Microsprayers with Accumulators
- Flow Rates and Plugging

Chapter 5. Hose Friction and Hydraulics

- General
- Friction Computations
 - Darcy-Weisbach Equation
 - Hazen-Williams Equation Computations
 - Example Friction Computations
- Pressures Along A Hose
- Spaghetti and Coupling Losses for Microsprayers
- Hose Inlet Pressure Computations

Chapter 6. Strategies for Sizing Pipes and Hoses Throughout A System

- Introduction
 - Design Tools
 - Design Procedures
- Pipeline System Description
 - Conventional Description
 - Holistic Description
 - Critical Path
- Possible Pipeline Sizing Strategies
- Summary of Pressure Regulation Strategies For Drip/Micro

Chapter 7. Pressures, Pipe Sizing, And Pipe Positioning

- Manifold Pipe Positioning on Sloping Ground

- Determination of Allowable Pressure Differences in The System

- Pre-Set Pressure Regulators

 - General

 - Inlet Flow Rate Determination with Pre-Set Pressure Regulators

Chapter 8. Filtration (Solids Removal)

- Introduction

- Reservoirs

- Pre-Screening

 - Simple Bar Grills (Debris Racks)

 - Perforated, Flat Steel Screen Plates

 - Rotating, Self-Cleaning Screen Belts

 - Self-Cleaning Rotating Screen

- Gravity Overflow Screens

- Centrifugal-Action Sand Separators

- Tubular Screen Filters

- Media Tanks

 - Introduction

 - Application

 - Media Selection

 - Selection Of The Number And Sizes Of Tanks

 - Media And Tank Sizing Summary

 - Underdrain Design

 - Accessory Hardware For Media Tanks

 - Initial Cleaning Of The Media

 - Backflush Adjustments

 - Obtaining Sufficient Backflush Flow Rates

 - Backflush Water Disposal

 - Tank Materials And Coatings

 - Pressure Ratings

- Disc Filters

- Rotary Cleaning Tubular Screen Filters

- Other Special Screen Designs

Chapter 9. Chemical Injection for Water Treatment

- Introduction

- Uniformity

- Constant Rate vs. Variable

- Injector Location

- Other Injection Notes

- Plugging Prevention

- Slimy Bacteria
- Iron and Manganese Oxides
- Iron and Manganese Sulfides
- Calcium and Magnesium Carbonate Precipitation
- Agronomic Purposes

Chapter 10. Irrigation Consumer Bill Of Rights(Tm)

Section 2.

Row Crop Drip

Chapter 11. Introduction to Row Crop Drip

Chapter 12. Background

Chapter 13. Benefits From Row Crop Drip

- Water Savings
- Energy Savings
- Crop Yield and Quality Improvements
- Other Grower Benefits
- Total Energy Consumption
- Remaining Concerns
- Crop Response to Row Crop Drip

Chapter 14. Typical Field Layouts (Designs)

Chapter 15. Management and Design Considerations

- Reducing Root Intrusion Problems
- Prevention of Soil Back-Siphoning into The Tape
- Tape Installation/Extraction Equipment
- Tape Orientation
- Tape Depth Placement
- Hole Spacing
- Low Flow vs. Medium Flow vs. High Flow Path
- Tape Wall Thickness
- Tape Materials
- Emitter/Outlet Design
- Initial Damage from Crushing of Tape, Insects
- Salinity and Using Sprinklers vs. Drip for Germination/ Transplanting
- Fertigation Location
- Flushing
- Flow Rate/Acre

- Land Preparation
- Minimum Land Area for A Trial
- Land Grading
- Tape Alignment
- Manifold Materials
- Other Rules

Chapter 16. Design Of Tape/Hose Laterals

- Manifold/Tape Connections
- Distribution Uniformity Concept
- Emitter Discharge Exponents
- Tape/Hose Friction

Chapter 17. Sizing Of Supply (Header) And Flushing Manifolds for Row Crop Drip

- Introduction
- Required Tape Inlet Pressure During Flushing
- Required Tape Inlet Flow Rate During Flushing

Chapter 18. Example Design of Manifold Sizing

- Conclusions

Chapter 19. Grower Explanation of Drip System Characteristics

Section 3.

Permanent Buried Drip On Trees/Vines

[Back To Top](#)

Chapter 20. Permanent Buried Drip On Trees/Vines

- Major Problems
- Burial Depth
- Hose and Emitter Selection
- Surface Water Ponding
- Air Vents
- Hydraulics
- Location of The Hoses
- Other

Section 4.

Design Examples 1A & 1B: Drip Irrigation

[Back To Top](#)

Chapter 21. Design Examples 1A & 1B: Drip Irrigation

Given Conditions

Find

Solution

1. Estimate the Gph/Vine Needed
2. Estimate the Number of Emitters/Vine
3. Examine the Number of Irrigation Blocks Needed
4. Determine the Allowable Pressure Difference between Emitters

Design #1A: Pressure Regulator At Each Hose

4. Determine the Allowable Pressure Difference between Emitters (Cont.)
5. Selection of the Proper Pre-Set Pressure Regulator
6. Manifold (Submain) Pipe Positioning on Sloping Ground
7. Hose Hydraulic Calculations
8. Submain (Manifold) Pipe Sizing
9. Filtration
10. Flow Meter
11. Total Dynamic Head Required From the Pump

Design Example 1B: Drip Irrigation

4. Design Parameters
5. Design Strategy
6. Manifold Pipe Positioning on Sloping Ground
7. Submain Sizing
8. Pressure Required At the Inlet To Each Submain
9. Mainline Sizing
10. Filtration, Etc.
11. Total Dynamic Head Required From the Pump

Section 5.

Design Example 2: Microspray Design

Chapter 22. Design Example 2: Microspray Design

Given Conditions

Solution

1. Estimate the Gph/Tree Needed
2. Estimate the Number of Sprayers/Tree
3. Examine the Number of Irrigation Blocks Needed
4. Determine the Allowable Pressure Difference between Emitters/Sprayers
5. Hose Design
6. Pressure Regulator Selection And Adjustment Of Flow Rates
7. Block Configurations
8. Buried Pvc Pipe Sizing
9. Filtration
10. Chemical Injection
11. Flow Meter
12. Total Pumping Pressure Required
13. Reducing the Total Pumping Pressure Required

Appendix

Index

References

Questions or comments:

Questions and comments about the manual should be directed to:

Irrigation Training and Research Center (ITRC)
Department of Agricultural Engineering
California Polytechnic State University (Cal Poly)
San Luis Obispo, California 93407
PH: (805) 756-2434
FAX: (805) 756-2433

ORDERING INFORMATION:

Copies of this publication can be ordered from:

Irrigation Training and Research Center (ITRC)
Department of Agricultural Engineering
California Polytechnic State University (Cal Poly)
San Luis Obispo, California 93407
PH: (805) 756-2434
FAX: (805) 756-2433